National Ice Center Visiting Scientist Program

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LONG TERM GOALS

The long-term goal of the National Ice Center (NIC) Visiting Scientist Program is to recruit the highest quality visiting scientists in the ice research community for the broad purpose of strengthening the relationship between the operational and research communities in the atmospheric and oceanic sciences.

OBJECTIVES

The first objectives of the program was to recruit a senior visiting scientist to:

- Build and lead the activities of the NIC Science Center.
- Be a source of expertise for the NIC and the science community.
- Act as a liaison with the outside science community for the purpose of identifying work ready for validation and transition to an operational environment.

Further objectives include recruitment of scientific visitors and recent PhDs who are interested in conducting applications-oriented research and product evaluation of relevance to the NIC ice-monitoring mission. The visiting scientists are a source of expertise for the NIC as well as mentors to the recent PhDs.

A final objective is to assist NIC, through the visiting scientist program, to act as a focus for interagency cooperation.

APPROACH

1. In the short-term: definition and implementation of in-house team and facilities, in consultation with Science Program sponsors and NIC management.

2. In the medium-term:

   - Evaluation of existing (US and foreign) products and algorithms which have the potential to support ice operations, with feedback to the scientific and algorithm development community and algorithm review panels.

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- Publicizing of NIC operational requirements within the scientific community.

- Recommendation and initiation of new algorithm and product developments, in consultation with key research groups.

3. In the long-term:

   - Development of new algorithms and products in collaboration with key groups.

   - Migration of algorithms to NIC operational environment and DAACs, as appropriate.

ACCOMPLISHMENTS

1. The recruitment process (search, selection and appointment) of several scientific and postdoctoral visitors positions was completed recently and these appointments will begin in the near future. Two offers have been made.

2. Following consultation with NASA, a white paper was written in collaboration with Dr. K. Steffenof the University of Colorado. This was entitled "Proposed development of a joint scientific-operational Arctic-wide sea-ice product" and was circulated to relevant agencies. The document described how, at the wide coverage "strategic" scale, scientific and operational requirements for sea-ice information overlap sufficiently that a single product could go some way towards addressing the requirements of both communities. The paper reviewed data assimilation techniques for moving sea-ice monitoring forward, and showed how such a program could build on already-funded developments in operational sea-ice modeling through the ONR PIPS program and would directly benefit this program. This activity was aimed at addressing medium term objectives including publicizing operational requirements within the scientific community and recommending new algorithm and technique developments.

3. A prototype operational SSMI algorithm, based on data fusion, has been implemented and is undergoing evaluation. Initial results are encouraging. This scheme (called the "SSMI interpolation scheme)" has been designed in consultation with NIC operational personnel to ensure that it meets their requirements in terms of fitting in with the current analysis procedure, whilst at the same time improving the quality of the product. The scheme operates by taking ice charts generated at the National Ice Center using RADARSAT, OLS and AVHRR data (and any reconnaissance data), converts these to a raster ice concentration format and then fits a mapping function that relates the principal components of the SSMI brightness temperature data to the ice chart ice concentrations. This is a simple, linear function. This mapping function is then used to "interpolate" ice concentrations elsewhere in the ice chart where cloud or imaging limitations preclude the use of high resolution data. The use of such a mapping function ensures that the algorithm is tuned to the region and time of interest and, in principle, will go some way towards counteracting the physical limitations of the SSMI sensor by (for example), enhancing the mapping coefficients during summer to compensate for the effect of melt water on the ice. The conventional analysis procedure would involve the use of ice concentrations derived using the NASA Team algorithm, which is not tuned to the region or area of interest and does not make use of any ancillary data.

4. NOW campaign. The NIC science team were involved in the North Water campaign in collaboration with the Canadian Ice Service and others. This involved the collection of a comprehensive test data set including a wide range of remote sensing data, both satellite-, helicopter- and ship-borne, plus surface measurements. The test data set has been organized so that it will provide a resource for future algorithm testing and research, in line with our stated mission of assisting the scientific community with resources for evaluating their techniques. In addition, specific projects are underway including the analysis of data from the ship-borne radiometer system, which has been tied in with digital video data and ground survey sites to test new SSMI algorithms and the sensitivity of the sensor to new ice. A theoretical model of passive microwave signatures has been implemented as part of the NIC contribution to this project that treats the sea ice as an ice layer overlain by snow.

5. A collaboration with the Danish Meteorological Institute is underway. This has already resulted in the working visit of a scientist - Soren Andersen - from that institute. Sources of funding have been identified for a return visit by one of the new science program post-doctoral fellows, early in 1999. The area of joint research is related to SSMI and the improvement of atmospheric corrections. The precise direction of the research is to be refined further pending completion of the appointment of the post-doctoral fellow at NIC. This activity feeds directly into our objective of evaluating US and foreign algorithms and products, with the Danish Met. Institute probably being the most active European center for development of operational ice products.

6. Scientific support to the National Ice Center. The science program has involved providing scientific support to the Director of Operations, in monitoring of contracts related to development of SAR algorithms and future planning issues. This activity is valuable in ensuring that the senior scientist is aware of evolving operational requirements.

7. We have taken on a student assistant to manage and support the data and software facilities of the science program. This student is funded separately through NIC.

SCIENTIFIC/TECHNICAL RESULTS

1. A suite of image analysis algorithms has been developed and installed under AVS - a visual programming and data visualization display tool. Some 60 programs have been written, broadly divided into (a) data ingestion programs, (b) statistical programs (eigenvector analysis, least squares, etc.), (c) theoretical modeling (passive microwave) and (d) data visualization.

2. Initial results of the SSMI Interpolation Scheme described above are encouraging. For summer data, the scheme has a bias of +2.8 in ice concentrations compared to a single ice chart, compared to -8.0% for the NASA Team algorithm. However, this is a very early result - the evaluation needs to be extended significantly before any firm conclusions can be drawn.

3. As background work to the SSMI interpolation scheme, some analysis of the principal components of the SSMI data have been carried out which suggest that whilst the two principal components of the 7 channel SSMI data relate to total and old ice concentration, a third principal component has variance above the noise level and probably is related to snow conditions (albeit with weather artifacts included -this component is strongly related to the 85 H Ghz and 37V channels). Theoretical modeling is being used to attempt to clarify the most significant influences on the SSMI channels in ice after the presence of open water and fresh (old) ice. If this third component is

related to some other geophysical characteristic of the ice, then this could be very useful, even with weather sensitivity.

4. Although the science program has provided only a supporting role, two SAR image classification systems that NIC has sponsored have been delivered to NIC and are undergoing evaluation. These include systems from the Univ. Kansas and the Univ. Colorado for classifying sea-ice using RADARSAT data. The science program has been involved providing advise into the evaluation and tuning of these systems.

IMPACT FOR SCIENCE (and/or) SYSTEMS APPLICATIONS

UCAR's Visiting Scientist Programs have served many federal agencies in developing valuable partnerships between the research and operational communities. The benefits have included an influx of new ideas and collaborations, and the improvement of products for the agency, the scientific community and for society at large.

TRANSITIONS

Nothing to report at this time.

RELATED PROJECTS

The North Water experiment is a related project which NIC is involved in.

PUBLICATIONS

Partington, K.C, 1998: Discrimination of Snow and Ice Facies Using Multi-Temporal SAR Data. *Journal of Glaciology,* vol. 44, no. 146, pp. 42-53.

Partington, K.C, 1998: Antenna Beamwidth and Pointing Accuracy - Induced Errors in Topographic Monitoring from Space. *IEEE Trans Geoscience and Remote Sensing*, vol. 36, no. 1, pp.312-316.

PATENTS

None

HONORS/AWARDS/PRIZES

None